

## **REMARKS**

### **Rejection Under 35 U.S.C. § 103 in view of Frame et al. and Cooper et al.**

Claims 11-19,21 and 25-28 are rejected as allegedly being obvious in view of Frame et al. (U.S. '525) in combination with Cooper et al. ('989). This rejection is respectfully traversed.

Frame et al. disclose a process for treating a sour hydrocarbon fraction, wherein mercaptans within the hydrocarbon fraction are reacted with hydrogen in the presence of a selective hydrogenation catalyst. In addition, the process comprises oxidizing mercaptans by reaction with an oxidizing agent in the presence of an oxidization catalyst and a basic component. The selective hydrogenation step and the oxidation step may be carried out in any order. See, e.g., column 10, lines 47-55.

In Example 1 at column 11, a feed comprising kerosene containing hydrogen is fed to a catalytic reactor. The product obtained from this hydrogenation step is divided into equal portions. One portion is processed through the hydrogenation reactor a second time. Thereafter, fresh feed, the once hydrogenolysed feed, and the twice hydrogenolysed feed are each subjected to an oxidation step wherein the feeds are contacted with an oxidation catalyst.

Example 2 at columns 12-13 describes a process arrangement wherein a feed comprising kerosene containing mercaptan sulfur and no hydrogen sulfide is subjected to hydrogenation in a reactor containing a catalyst to which hydrogen is also fed. The resultant hydrogenolysed products are then subjected to oxidation to oxidize the mercaptans. However, prior to oxidation, the hydrogenolysed products are passed through a molecular sieve bed to remove hydrogen sulfide produced by the hydrogenation. See also Example 3 which describes introducing hydrogenolysed products into a molecular sieve bed, prior to oxidation.

In the rejection, it is alleged that Frame et al. disclose supplying effluent from at least one selective hydrogenation reactor into a "stabilization drum." In support of this assertion, the rejection cites column 11, line 43 - column 14, line 10, which relate to Examples 1-4. Further, the Examiner argues that the reference by Frame et al. to "4A molecular sieve bed" is a stabilization drum in accordance with applicants' claims if "stabilization drum" is given its broadest reasonable interpretation. Applicants disagree.

The molecular sieve bed in Frame et al. is used to remove a gaseous component, namely hydrogen sulfide, from a gas phase. The hydrogenolysed effluent is introduced into the molecular sieve bed, hydrogen sulfide is removed from the hydrogenolysed effluent by adsorption onto the bed of molecular sieves, and then the resultant treated effluent is sent to oxidation. Frame et al. do not describe or suggest any gas/liquid separation occurring in the molecular sieve bed and thus do not describe or suggest any vessel which contains the molecular sieve bed that is connected to an effluent outlet line from a hydrogenation reactor and that has at least one gas outlet line and at least one stabilized effluent outlet line.

Furthermore, the rejection provides no rational as to why one of ordinary skill in the art would consider an interpretation of stabilization drum, in the context of applicants' invention, to encompass a molecular sieve bed. To stabilize the effluent from a hydrogenation reactor, the stabilization drum needs to have a sufficient open volume and open cross section to permit gas/liquid separation to efficiently occur. The rejection provides no explanation as to how a vessel containing a bed of molecular sieves could be reasonably interpreted as providing such stabilization.

Furthermore, regardless of how one interprets "stabilization drum" and the molecular sieve bed of Frame et al., it is clear that Frame et al. do not disclose a line for recycling stabilized effluent from its molecular sieve bed to the hydrogenation reactor. Compare applicants' claim 12.

In addition, in the examples of Frame et al., the hydrogenation catalyst used is a nickel catalyst. While Frame et al. describes a wide variety of catalytic materials at column 3, lines 2-16, there is no suggestion that would lead one of ordinary skill in the art to select a catalyst containing 0.1-1 weight % palladium or 0.1-1 weight % palladium and 1-20 weight % nickel. Compare claims 15 and 19.

Cooper et al. disclose a process in which an aerated liquid hydrocarbon feed stream containing mercaptans is contacted with a liquid aqueous caustic solution in a reaction vessel whereby mercaptans are converted to disulfides. Referring to the figure, an effluent stream 8, which contains disulfides, hydrocarbons, and dissolved nitrogen, is removed from oxidation reaction vessel 6 and introduced into a separator vessel 20 to produce a degassed liquid product

stream 12 and an overhead vapor stream 22 containing removed nitrogen. A portion 14 of the degassed liquid product stream 12 is recycled back to reaction vessel 6. This portion of degassed liquid product stream can be combined with a sour hydrocarbon stream 16 to form a blended stream 17 which can additionally be admixed with an air stream 18 to provide an aerated liquid feed stream 2.

Cooper et al. do not disclose a selective hydrogenation reactor, nor do they disclose a separation drum upstream of a sweetening reactor. Particularly, Cooper et al. do not disclose a stabilization drum positioned between a selective hydrogenation reactor and a sweetening reactor.

Moreover, Cooper et al. fail to provide any disclosure or suggestion of a recycle line for recycling stabilized and sweetened gasoline from a sweetening reactor to a hydrogenation reactor. As noted above, recycle line 14 recycles effluent from a sweetening reactor back to the same sweetening reactor, not to a selective hydrogenation reactor. Compare Applicants' claims 13 and 14.

Thus, neither Frame et al. nor Cooper et al. provide any disclosure or suggestion of a stabilization drum positioned between a hydrogenation reactor and a sweetening reactor. While Cooper et al. disclose a separation vessel, this vessel is positioned downstream of a sweetening reactor, not upstream of a sweetening reactor and downstream of a hydrogenation reactor. As for Frame et al., the disclosed molecular sieve bed does not suggest a stabilization drum, as discussed above.

Furthermore, while Cooper et al. disclose recycling degassed, sweetened effluent back to the sweetening reactor, neither Cooper et al. nor Frame et al. provide any disclosure or suggestion of recycling a stabilized and sweetened gasoline from a sweetening reactor to a hydrogenation reactor. See claims 13-14.

Also absent from the disclosures of Frame et al. and Cooper et al. is a recycle of stabilized effluent from a stabilization drum to a selective hydrogenation reactor. As discussed above, Frame et al. does not disclose a recycle to the hydrogenation reaction from the molecular sieve bed, let alone from a stabilization drum. Further, Cooper et al. does not disclose a hydrogenation reactor, let alone a recycle thereto from a stabilization drum. Compare

Applicant's claim 12.

Frame et al. do disclose dividing the product from a hydrogenation reactor so that one portion of the product is sent back to the hydrogenation reactor. But, Frame et al. provide no suggestion of first introducing the effluent into a stabilization drum having an outlet for removing a separated gaseous fraction, and recycling a degassed effluent from that stabilization drum to a hydrogenation reactor. As noted above, Cooper et al. provide no disclosure or suggestion with regards to hydrogenation reactors.

In view of the above remarks, it is respectfully submitted that Frame et al., taken alone or in combination with the disclosure of Cooper et al., fails to provide any suggestion that would motivate one of ordinary skill in the art to modify the process of Frame et al. in such a manner as to arrive at an embodiment in accordance with Applicants' invention. Withdrawal of the rejection under 35 U.S.C. § 103 is respectfully requested.

**Rejection Under 35 U.S.C. § 103 in view of Frame et al., Cooper et al. and Boitiaux et al.**

Claim 20 is rejected as allegedly being obvious in view of Frame et al. (U.S. '525) in combination with Cooper et al. ('989) and Boitiaux et al. (US '779). This rejection is respectfully traversed.

The disclosure of Frame et al. and Cooper et al. are discussed above. Boitiaux et al. (US '779) discloses a catalyst for use in selective hydrogenation of diolefinic and acetylenic hydrocarbons. The catalyst contains an inorganic carrier, 0.03-1 wt.% palladium and 0.003-0.3 wt. % gold. See, e.g., Example 1 wherein a catalyst is prepared having a palladium content of 0.2% by weight and a gold content of 0.002% by weight.

However, US '779 does not overcome the discrepancies discussed above regarding the combination of Frame et al. and Cooper et al. US '779 does not disclose or suggest a stabilization drum positioned between a hydrogenation reactor and a sweetening reactor. Nor does US '779 disclose a recycling of stabilized and sweetened gasoline from a sweetening reactor to a hydrogenation reactor. US '779 also provides no disclosure or suggestion of a recycle of stabilized effluent from a stabilization drum back to a selective hydrogenation reactor.

In view of the above remarks, withdrawal of the rejection under 35 U.S.C. § 103 is

respectfully requested.

**Rejection Under 35 U.S.C. § 103 in view of Frame et al., Cooper et al., Boitiaux et al. and Hearn et al.**

Claim 22 is rejected as allegedly being obvious in view of Frame et al. (U.S. '525) in combination with Cooper et al. ('989), Boitiaux et al. (US '779), and Hearn et al. (US '476). This rejection is also respectfully traversed.

The disclosures of Frame et al., Cooper et al., and Boitiaux et al. are discussed above. Hearn et al. (US '476) discloses a process for removing sulphur from a hydrocarbon stream having a naphtha boiling range. During the process, the hydrocarbon stream and hydrogen are introduced into a first distillation column reactor 10. See flow lines 1 and 2 in the figure. A fraction of the hydrocarbon stream containing mercaptans, diolefins and a substantial portion of olefins moves upward into distillation reaction zone 11, which contains a Group VIII metal hydrogenation catalyst. Sulfides, thiophenes and the higher boiling fraction of the hydrocarbons are removed as a bottom stream from the first distillation column reactor. The bottom stream, along with a hydrogen stream, are introduced into a second distillation reaction zone 21 which contains a hydrodesulphurization catalyst whereby a portion of the sulfides and thiophenes are reacted with hydrogen to form H<sub>2</sub>S. The H<sub>2</sub>S is removed as a gas from the top of the second distillation column reactor and naphtha product is removed from the bottom of the second distillation column reactor.

Referring to the figure, in the distillation reaction zone 11 of the first distillation column reactor 10 substantially all mercaptans are reacted with diolefins in order to form higher boiling sulfides. The lower portion of the first distillation column reactor 10, i.e., below distillation reaction zone 11, functions as a stripping zone whereby the higher boiling hydrocarbons are separated from lighter components. In addition, the diolefins formed in the reaction zone 11 are also separated from the lighter fraction. The lighter fraction which is substantially sulphur free is removed as an overhead from the first distillation column reactor 10 via flow line 3.

US '476 fails to overcome any of the discrepancies with regard to the combination of Frame et al., Cooper et al., and Boitiaux et al. US '476 provides no disclosure or suggestion of a

stabilization drum positioned between a hydrogenation reactor and a sweetened reactor. Similarly, US '476 provides no disclosure of recycling a stabilized sweetened gasoline from a sweetening reactor back to a hydrogenation reactor. Further, US '476 provides no disclosure or suggestion of recycling a stabilized effluent from a stabilization drum to a selective hydrogenation reactor.

In view of the above remarks, it is respectfully submitted that Frame et al., taken alone or in combination with Cooper et al., Boitiaux et al., and/or Hearn et al., fails to render obvious Applicants' claimed invention. Withdrawal of the rejection under 35 U.S.C. § 103 is respectfully requested.

**Rejection Under 35 U.S.C. § 103 in view of Frame et al., Cooper et al., and Hearn et al.**

Claim 23 is rejected as allegedly being obvious in view of Frame et al. (U.S. '525) in combination with Cooper et al. (US '989) and Hearn et al. (US '476). This rejection is also respectfully traversed.

The disclosures of Frame et al., Cooper et al., and Hearn et al. are discussed above. In the rejection, Hearn et al. is said to disclose adding hydrogen directly to a selective hydrogenation reactor comprising two catalytic zones at a point between the two catalytic zones. This is incorrect. As shown in the figure of US '476, hydrogen is introduced into the lower section of the first distillation column reactor 10. This lower section acts as a stripping section. US '476 does not disclose that this lower section contains a catalyst bed. See, e.g., Column 6, lines 48-62.

Moreover, as discussed above, US '476 does not overcome the discrepancies in the combined disclosures of Frame et al. and Cooper et al.

In view of the above remarks, it is respectfully submitted that Frame et al., taken alone or in combination with Cooper et al. and/or Hearn et al., fails to render obvious Applicants' claimed invention. Withdrawal of the rejection under 35 U.S.C. § 103 is respectfully requested.

**Rejection Under 35 U.S.C. § 103 in view of Frame et al., Cooper et al., and Meguerian et al.**

Claim 24 is rejected as allegedly being obvious in view of Frame et al. (U.S. '525) in combination with Cooper et al. ('989) and Meguerian et al. (US '531). This rejection is also

respectfully traversed.

The disclosures of Frame et al. and Cooper et al. are discussed above. Merguerian et al. (US '531) discloses a process for sweetening cracked naphtha. As illustrated in the figure, the process involves delivering a stream of raw thermally cracked heavy naphtha, which contains mercaptans,  $H_2S$  and phenolic compounds, to a prewash vessel 13 wherein the feed stream is contacted with an aqueous caustic solution to remove  $H_2S$ . The resultant  $H_2S$ -free naphtha is removed from the top of the prewash vessel 13 and introduced into a mercaptan extractor 23. In the extractor, naphtha is contacted with an aqueous caustic solution containing cresylates, which are said to act solutizers for mercaptans. The resultant extracted naphtha is removed from extractor 23, delivered to a coalescer 51, and then subsequently introduced into sweetening vessel 57 where it is contacted with a gallic acid catalyst. Prior to entry into the sweetened vessel 57, the extracted naphtha is combined with an aqueous caustic solution and free oxygen (sources 61 and 67). However, the gallic acid catalyst is introduced by a separate line. See reference numerals 71 and 72.

US '531 does not disclose or suggest a sweetening reactor which is in fluid communication with a source of aqueous solution of an alkaline base containing a metal chelate catalyst via a supply line for introducing an oxidizing agent. As shown in the figure, the gallic catalyst and aqueous caustic solution now introduced into sweetening reactor 57 of US '531 via different lines.

Furthermore, US '531 does not overcome the discrepancies discussed above regarding the combination of Frame et al., and Cooper et al.

In view of the above remarks, it is respectfully submitted that Frame et al., taken alone or in combination with Cooper et al. and/or Meguerian et al., fails to render obvious Applicants' claimed invention. Withdrawal of the rejection under 35 U.S.C. § 103 is respectfully requested.

The Commissioner is hereby authorized to charge any fees associated with this response or credit any overpayment to Deposit Account No. 13-3402.

Respectfully submitted,



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